Armed Forces College of Medicine

AFCM

Hormone action and signal transduction

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INTENDED LEARNING OBJECTIVES (ILO)

By the end of this lecture the student will be able to:

1. **Compare between different types of hormones.**
2. **Explain the mechanism of action of lipophilic hormones.**

During the 19th century,

a series of four cholera outbreaks in England
left tens of thousands of people dead.

Due to disruption in hormone signaling

What is hormone?

Hormone is a signaling molecule produced by glands in multicellular organisms that are transported by the circulatory system to target distant organs to regulate physiology and behavior.

Signal transduction:

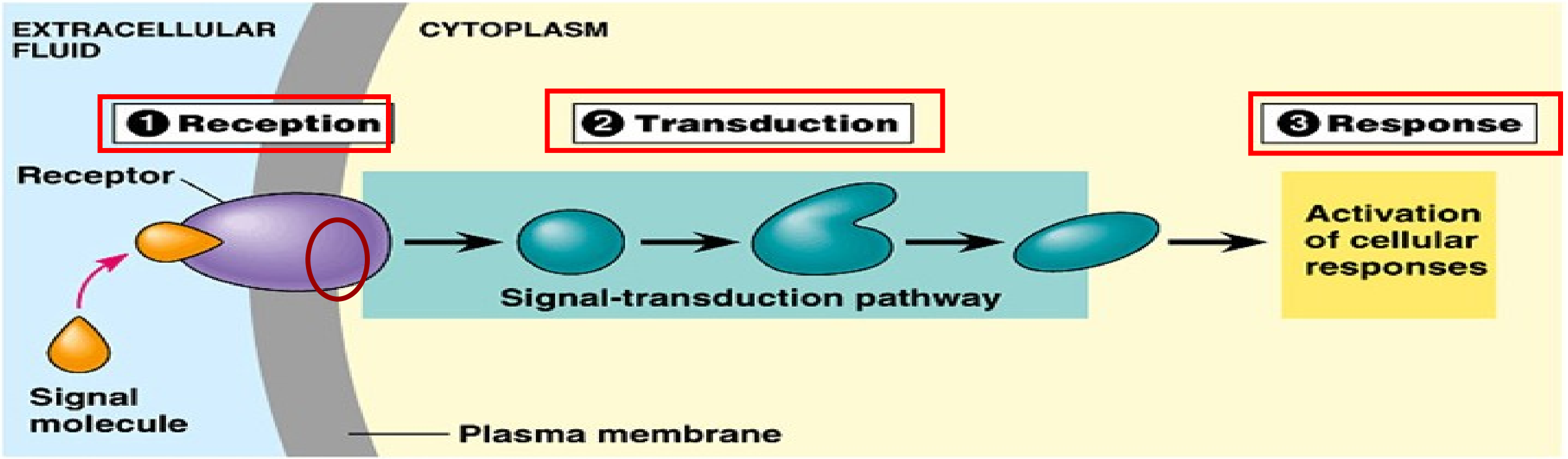
- **The process by which extracellular signals can be transduced (converted) into intracellular response**

- ***The signal:***

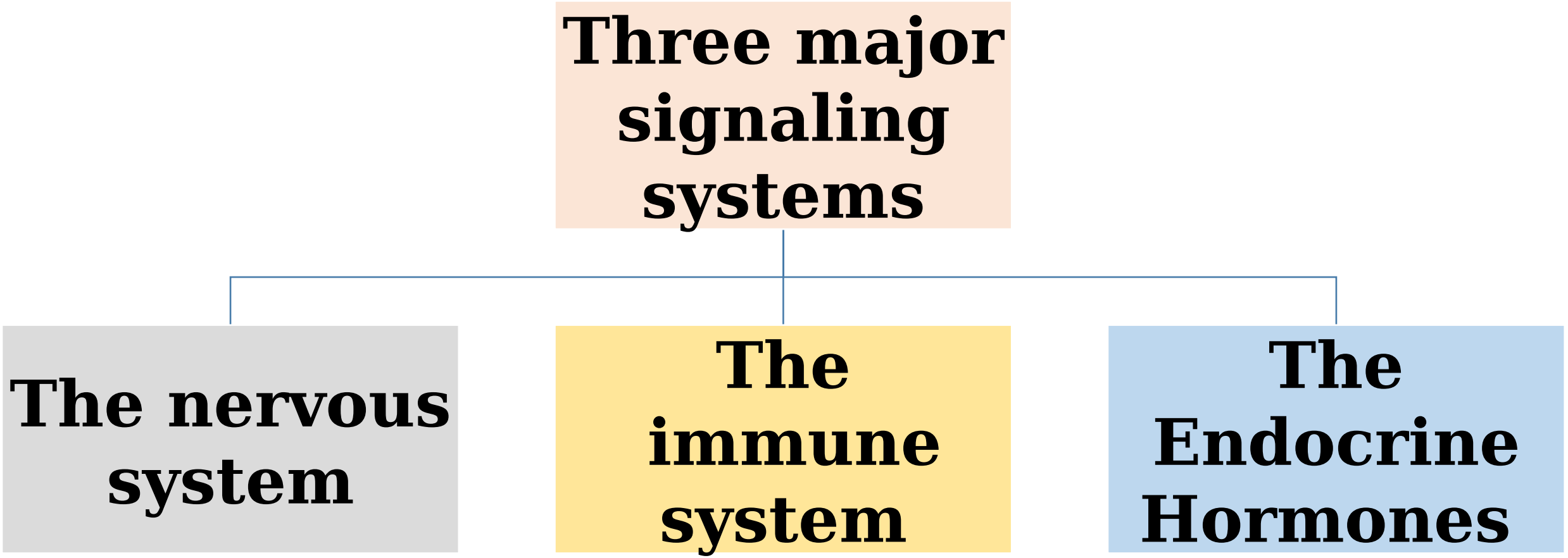
Represents information carried by chemical messengers like:

Hormones, neurotransmitters, growth factors

Signal transduction



extracellular signals* can be transduced (converted) into *intracellular response


Three major signaling systems
The nervous system
The immune system
The Endocrine Hormones

In the nervous system:

Chemical messengers are called

Neurotransmitters

In the immune system:

Chemical messengers are called

cytokines

Interleukins, Tumor necrosis factor

&

Interferons

In the endocrine system:

Chemical messengers are called Hormones

Act on distant target organs

Classification of hormones

Classification of hormones; according to.....

Distance of action

- **Autocrine**
- **Paracrine**
- **Endocrine**

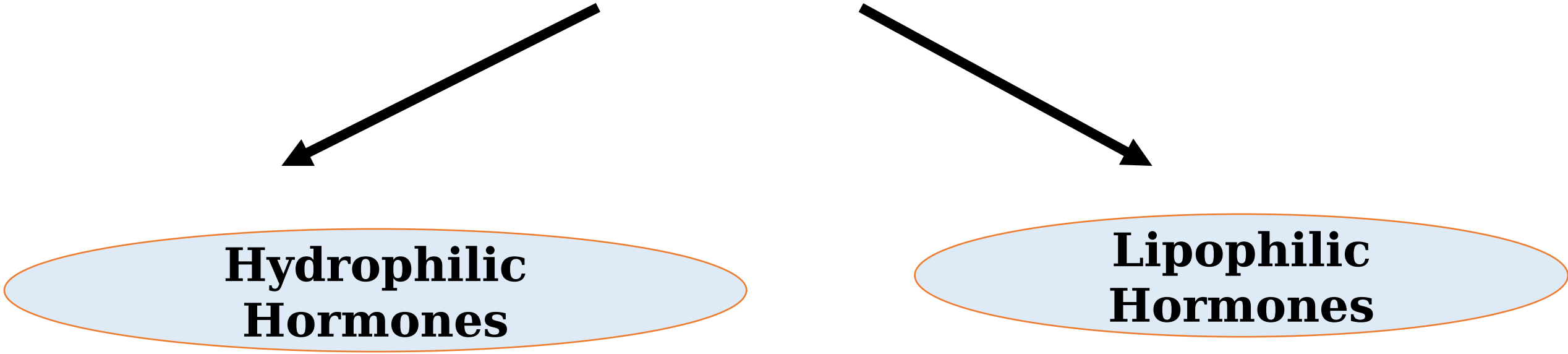
Chemical structure

- **Amino acid derivatives**
- **Peptides, polypeptides**
- **Steroid hormones**
- **Fatty acid derivatives**

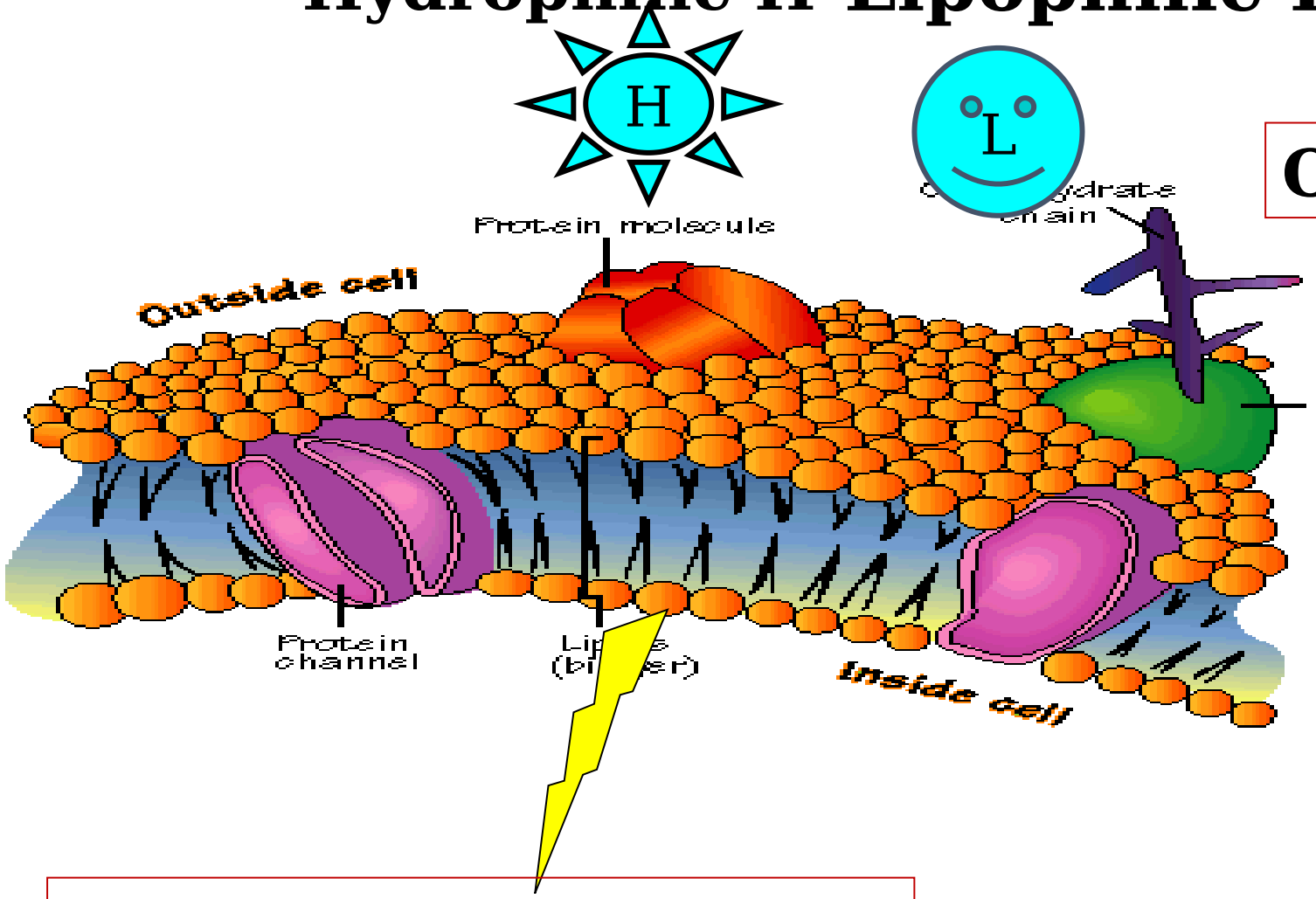
Solubility & mechanism of action

- **Hydrophilic Hormones**
- **Lipophilic Hormones**

According to solubility & Mechanism of action; hormones are classified to …..



Hydrophilic H **Lipophilic H**



Outside the cell

Cell membrane

Inside the cell

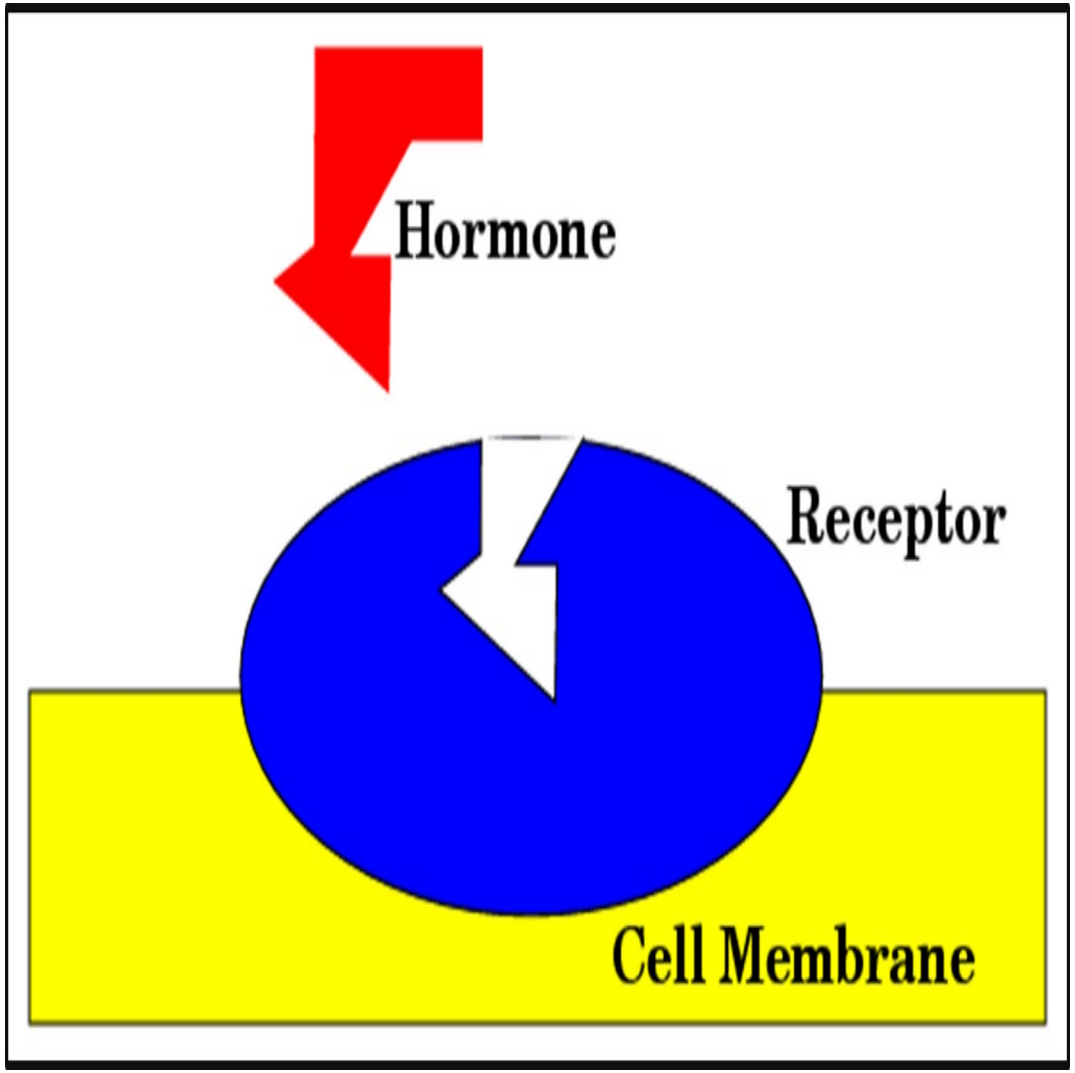
Second messenger mediates Hormone action

Hormonal receptors

- ***They are cell-associated recognition molecules:***

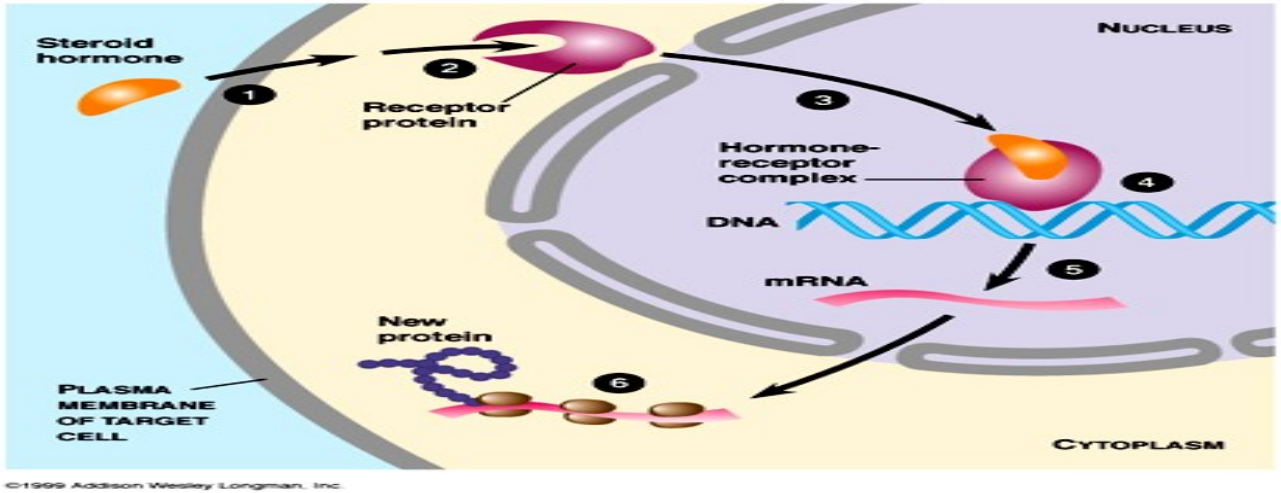
1) **Can recognize hormones**

2) **Bind specific hormones present at a very low concentration in the extracellular fluid**

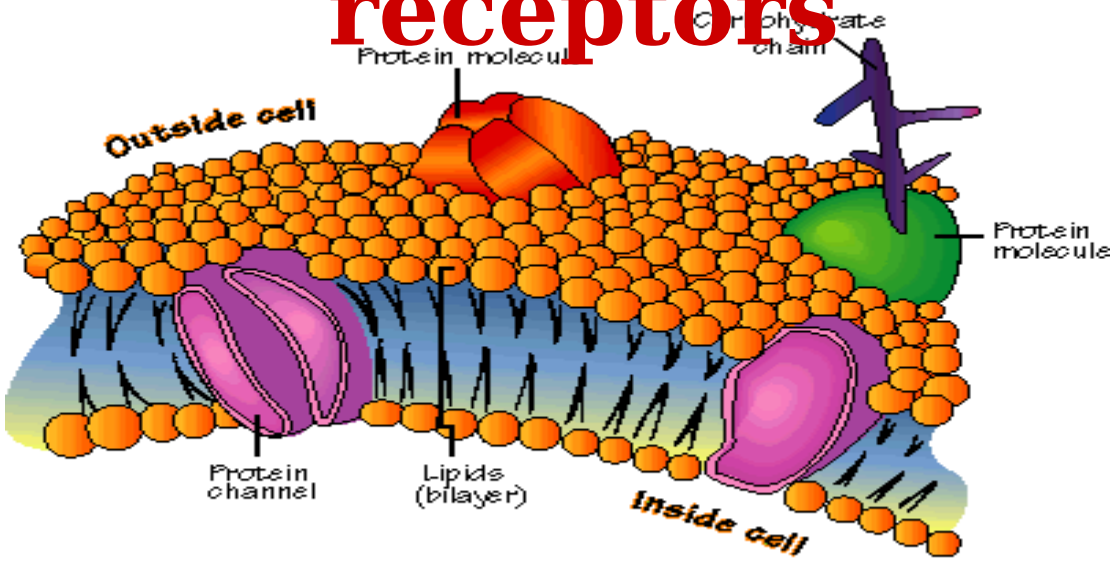


Types of Hormonal receptors

A- Intracellular receptors



B- Cell surface receptors



Lipophilic Hormones	Hydrophilic Hormones
They are steroid Hormones, Vit D and T3 ,T4	These are peptides, serotonin, melatonin, catecholamines
They are lipid soluble can cross cell membrane	They are water soluble can not cross cell membrane
They need transport proteins	They do not need transporter proteins
Long plasma half life (hours or days)	Short plasma half life (minutes)
Intracellular receptors	Cell membrane receptors
Hormone receptor complex	Mediators (second messenger) : cAMP, cGMP, Calcium, IP3

1- Lipophilic Hormones

1-Steroid hormones **Glucocorticoides (cortisol)**

Mineralocorticoides (aldosterone)

Male sex hormones (testosterone)

Female sex hormones (estrogen)

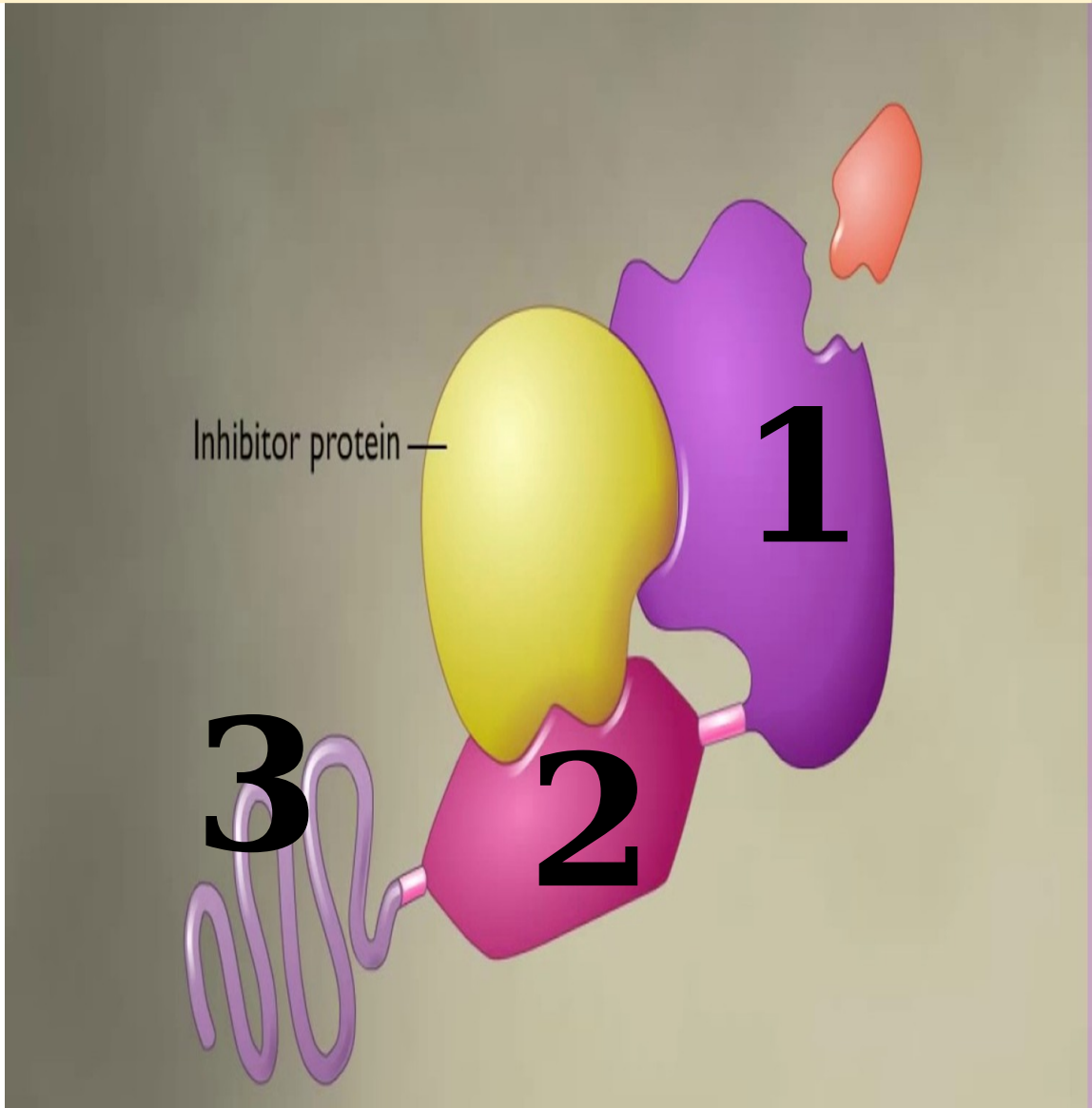
2-Calcitriol (active Vit D)

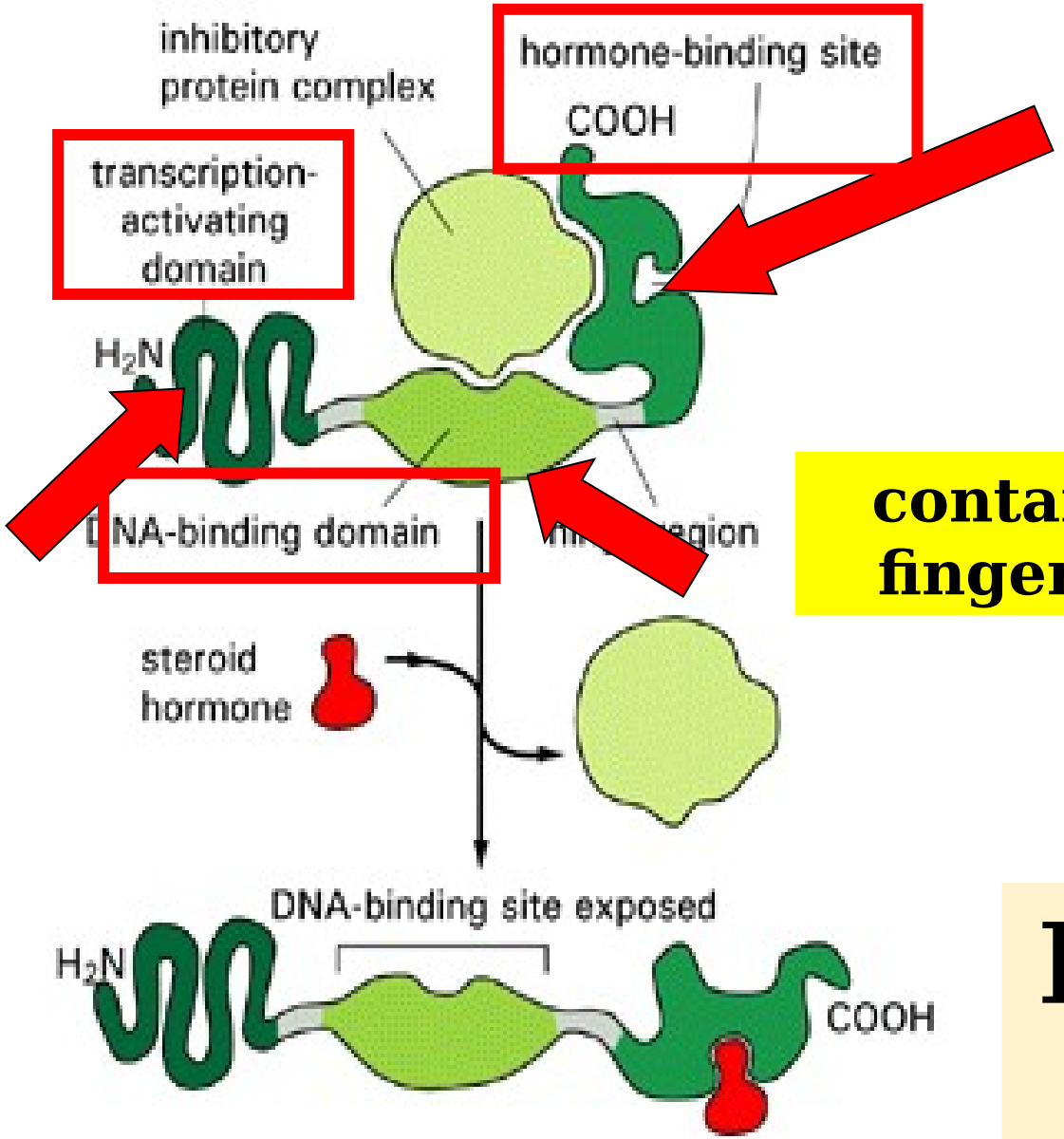
3-Thyroid hormones (T3 & T4)

Lipophilic hormones bind to Intracellular Receptors

- ***These receptors have three domains:***

1. **Carboxyl terminal region binds the hormone**
2. **Central DNA binding domain**
3. **Amino acid terminal domain acting as gene enhancer or gene**





Free receptor

contains zinc finger motifs

Hormone bound receptor

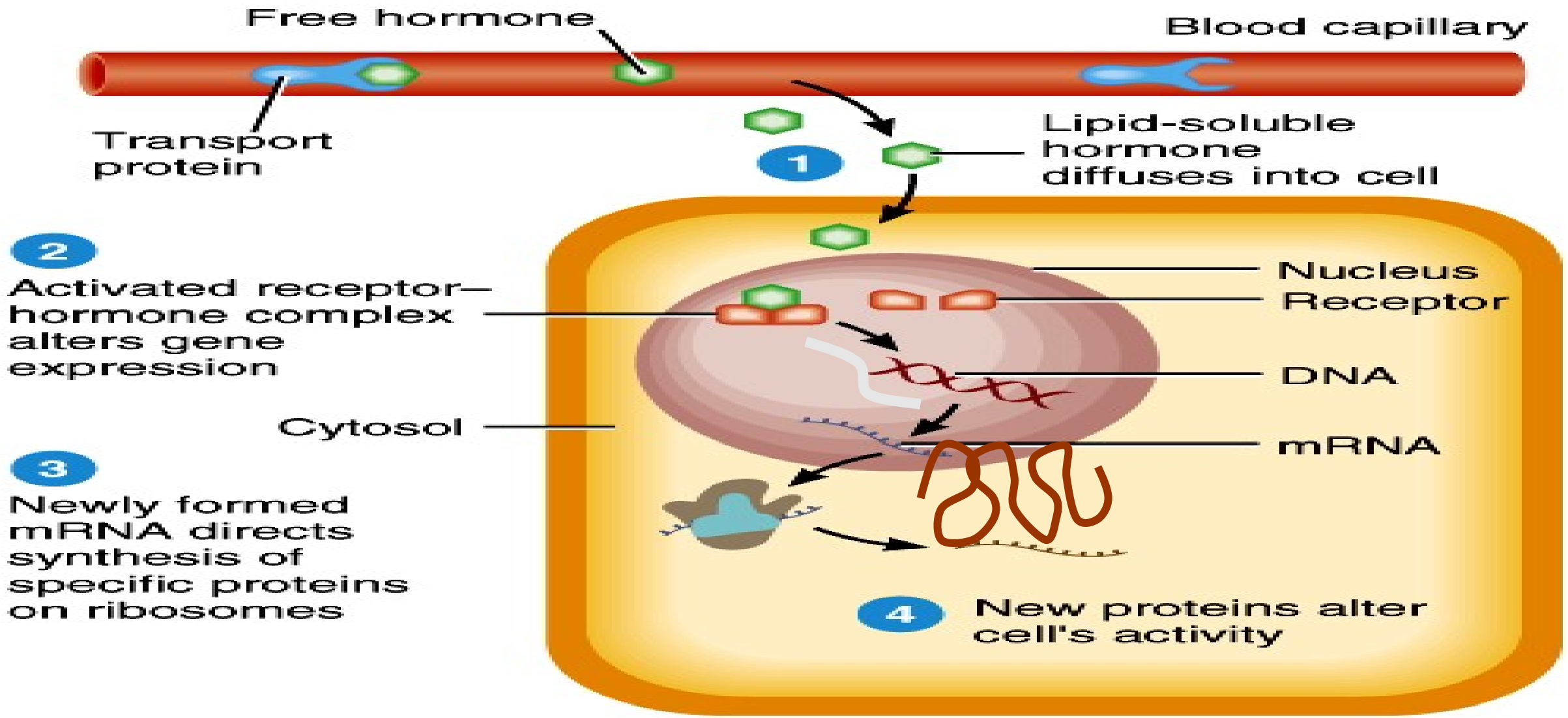
Lipophylic hormones bind to Intracellular Receptors

Intracellular Receptors are :

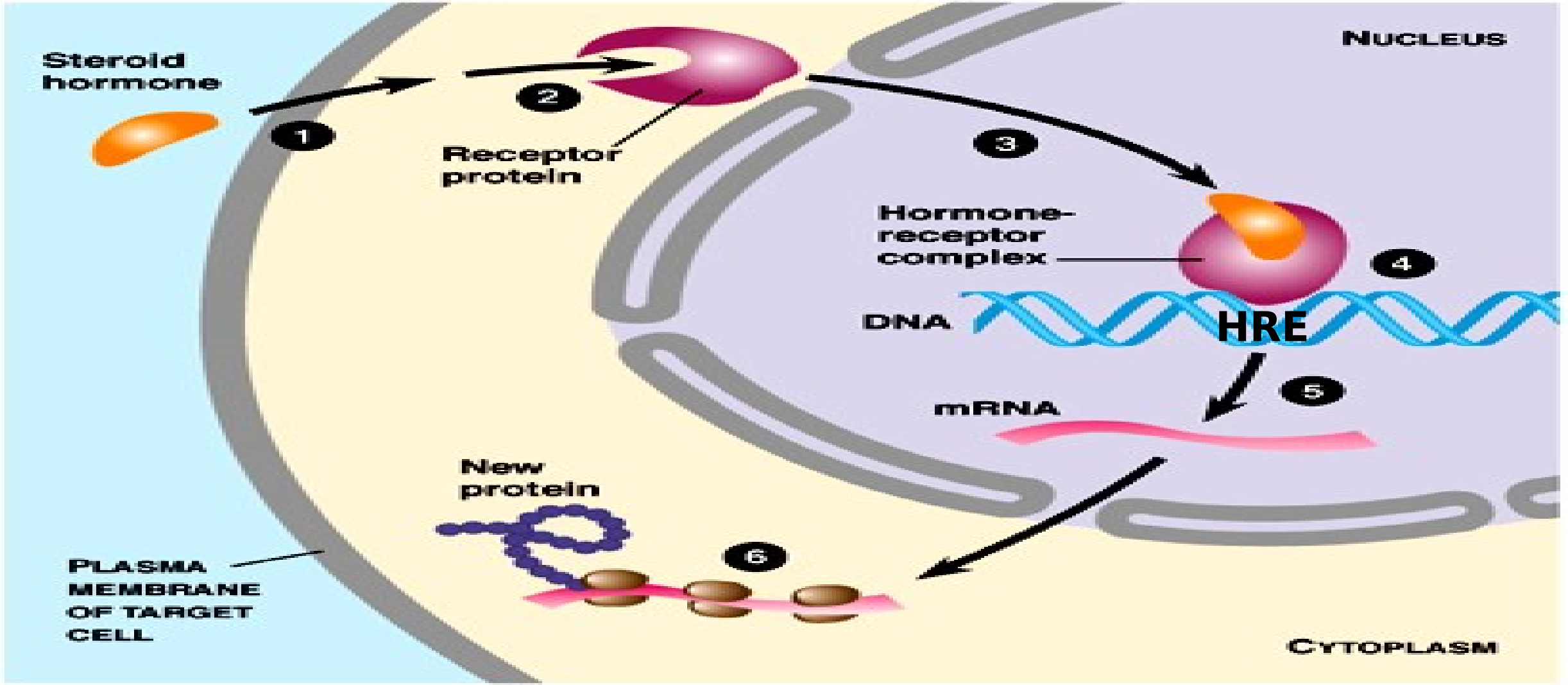
Cytoplasmic
As Steroid hormones receptors

Nuclear
As thyroid hormone receptors

Nuclear receptors



Cytoplasmic receptors



Binding of a steroid hormone to its intracellular receptor

Activation of the receptor

Translocate to the nucleus

Hormone–receptor complex binds to the hormone Response element (HRE) of the enhancer region

Activation of Gene promoter

Transcription

Which of the following regions within an androgen receptor protein contains zin finger motifs?

A. Cytosolic domain
B. DNA-binding domain
C. Gene regulatory domain
D. Ligand-binding domain
E. Transmembrane domain

Thank you